Ph.D. Synopsis

on

EXTRACTION, ISOLATION, IDENTIFICATION AND PHARMACOLOGICAL EVALUATION OF BIOACTIVE PHYTOCONSTITUENT FROM MEDICINAL PLANT OF MARATHWADA REGION FOR ANTIASTHMATIC ACTIVITY

Submitted to

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NANDED

For Doctor of Philosophy

In

Pharmacy

Under the faculty of

Sciences & Technology

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2024-25

ABSTRACT

Asthma is a widespread condition with increasing global prevalence, particularly in industrialized nations. It currently affects approximately 300 million people worldwide, and this number is expected to rise to 400 million in next few years. Historically, plants have been vital sources of medicinal remedies. Due to the limited success and side effects of conventional asthma treatments, many patients are turning to complementary and alternative medicine. Ancient texts, including Ayurveda and other Indian literature, highlight the use of plants in treating various ailments. India, with its rich biodiversity of around 45,000 plant species, boasts thousands of plants reputed for their medicinal properties.

Research conducted in recent decades on plants referenced in ancient texts or traditionally used for asthma has revealed their Antiasthmatic, antihistaminic, and ant allergic properties. A key focus in the research and development of medicinal plants is the identification, isolation, and characterization of bioactive compounds found in plant extracts. Phytochemical studies grounded in ethno pharmacology are regarded as an effective strategy for discovering new chemical compounds with potential as drug candidates. With this approach, the current study focuses on the "extraction, isolation, identification and pharmacological evaluation of bioactive phytoconstituent from medicinal plant of marathwada region for antiasthmatic activity"

The study will begin with the selection and authentication of a medicinal plant based on its traditional use and reported pharmacological potential. The plant material will authenticated by a qualified botanist. The authenticated plant material will then subjected to extraction using a soxhlet apparatus**,** employing a suitable solvent system to obtain a extract. The extract will subjected to phytochemical qualitative & quantitative evaluation. Subsequently, the extract will evaluated for its pharmacological activities, including anti-oxidant, anti-inflammatory and Antiasthmatic effects, using standard *in vivo* and *in vitro* models. Based on the results, the most potent extract will selected for fractionation using chromatographic techniques. The resulting fraction/s will further evaluated for their Antiasthmatic activity to identify the most active fraction. Finally, the bioactive fraction will subjected to advanced analytical techniques, such as LC-MS/GC-MS, to isolate and identify the phytoconstituent(s) responsible for the observed Antiasthmatic activity**.**

Keywords: Extraction , Antiasthmatic, Bioactive Compounds, Medicinal Plant, Chromatographic techniques

INTRODUCTION:

The respiratory system is a complex network of organs and tissues that facilitate breathing by enabling the body to take in oxygen from the air, which is essential for the proper functioning of organs. This system also helps remove harmful gases, such as carbon dioxide, from the bloodstream. It consists of airways, lungs, and blood vessels and can be categorized into the upper and lower respiratory tracts.

Infections of the lower respiratory tract can manifest through a variety of symptoms, including acute bronchitis, pneumonia, and chronic obstructive pulmonary disease (COPD), with patients experiencing cough, nausea, shortness of breath, and chest pain. Upper respiratory tract infections are characterized by self-limiting irritation and inflammation of the upper airways, typically presenting with cough but without pneumonia, particularly in patients with no underlying conditions or history of COPD, emphysema, or chronic bronchitis.[1-2]

Asthma is an airway disorder influenced by various intrinsic and extrinsic factors, including cold air, exercise, medications, genetics, and allergens such as dust, animal fur, or certain foods. The National Institutes of Health describes asthma as a chronic inflammatory disorder of the airways, where cellular components, particularly mast cells, T-lymphocytes, eosinophils, epithelial cells, and neutrophils, play a significant role. Symptoms of asthma include coughing, shortness of breath, wheezing, and a feeling of tightness in the chest. Individuals with asthma often exhibit elevated levels of IgE, which binds to mast cell receptors and inflammatory products. The interaction between antigens and IgE antibodies activates inflammatory cellular responses, releasing mediators like histamine and prostaglandins, which lead to the contraction of airway smooth muscles. [4-5]

Asthma affected an estimated about 35 million people in 2022 and caused 455000 deaths globally, most asthma-related deaths occur in low- and lower-middle-income countries, due to under-diagnosis and under-treatment. Current asthma therapy lacks satisfactory success due to adverse effect, hence patients are seeking complementary and alternative medicine to treat their asthma. Ayurveda and other Indian literature mention the use of plants in various human ailments. India has about 45,000 plant species and among them several thousand are claimed to possess medicinal properties, The medicinal properties offered by the plants are due to compounds synthesized in their secondary metabolism which includes flavonoids, alkaloids, tannins, steroids, glycosides, phenols, fixed oils, saponins etc. and are stored in the specific parts of plants such leaf, bark, flower, seed, fruit and root. These secondary metabolites and their derivatives exhibited significant biological and pharmacological properties. [3]

So various medicinal plants are available in traditional system for its effectiveness in respiratory disorders like asthma, chronic bronchitis etc but systematic studies of many plants yet to be explored. Many plants just evaluated for their preliminary activity but not for their extensive screening including that for bioactive guided isolation and characterization. Accordingly, the present study is aimed for,

"Extraction, Isolation, Identification and Pharmacological evaluation of bioactive phytoconstituent from medicinal plant of marathwada region for Antiasthmatic activity"

OBJECTIVES OF RESEARCH

Present study is aimed for "**Extraction, Isolation, Identification and Pharmacological evaluation of bioactive phytoconstituent from medicinal plant of marathwada region for Antiasthmatic activity**"

with objectives-

a) Phytochemical investigation & standardization of selected Medicinal Plant/s & their extract/s.
b) Screening for secondary activities like Antioxidant and anti-inflammatory activity of plant extract/s.
c) Pharmacological evaluation of plant extract/s and fraction/s for its anti-asthmatic activity.
d) Isolation, Identification and Pharmacological evaluation of bioactive phytoconstituent/s from the plant extract/s & fraction/s.
e) Toxicity study of extract/s to obtain safety data

PLAN OF WORK

1. **Literature review**
2. **Collection, identification and authentication of selected plant material**
3. **Processing of plant material**
4. **Pharmacognostic evaluation of plant material**

   Morphological evaluation, microscopic evaluation and powder characteristics
5. **Standardization of plant material**
   - Extractive Value & Ash content
   - Acid & Water-soluble ash
   - Foreign matter
   - LOD
6. **Extraction of selected plant material**
7. **Phytochemical Screening of selected plant extract/s for**

   a) Phytochemical Qualitative analysis
   - Chemical tests of Primary & secondary metabolites
   - TLC study

   b) Phytochemical Quantitative analysis
   - Total Phenolic Content
   - Total Flavonoid Content
8. **Pharmacological screening of plant extract/s for-**

   a) *In-vitro* Antioxidant study

   b) Safe dose calculation by acute oral toxicity studies and repeated dose toxicity study

   c) *In-vivo* anti-inflammatory activity

   d) *In-vitro* Antiasthmatic activity

   e) *In-vivo* Antiasthmatic activity
9. **Isolation & identification of Antiasthmatic bioactive constituent**

   i. Selection of extract

   ii. HRLC-MS Study of selected extract

   iii. Fractionation

   iv. Phytochemical evaluation of fraction/s

   v. Pharmacological screening of fraction/s

   vi. Identification of phytoconstituent
10. **Interpretation of data and its presentation**

RATIONALE OF STUDY:

Globally Bronchial asthma affects approximately 7–10% of the population which makes it one of the most common and chronic respiratory disorders. With an estimated 300 million individuals suffering worldwide and a significant burden of morbidity and mortality in low- and middle-income countries, there is an urgent need for alternative treatment options (WHO, 2004). The modern allopathic treatments provide symptomatic relief, their long-term efficacy is often limited, and also, they can cause significant side effects, especially with prolonged use or at higher doses. These drawbacks make it needed for safer, more sustainable remedies that can be involved into healthcare systems.

Nearly 80% of the global population, particularly in developing countries, relies on traditional herbal remedies for primary healthcare (WHO). India's rich cultural heritage of traditional medicine has long identified numerous plants with potential antiasthmatic properties & also the Herbal medicines are cost-effective, widely available, and often associated with minimal side effects compared to synthetic drugs.

Current asthma therapies are often incomplete in resolving the diverse pathophysiological mechanisms of the disease. Phytoconstituents derived from medicinal plants, including alkaloids, flavonoids, and saponins, have demonstrated bronchodilatory, anti-inflammatory, and immunomodulatory effects, which can address the unmet needs in asthma management.

The high mortality and under diagnosis rates in countries like India recommends the need for accessible and effective treatments. Thereby exploring medicinal plants to develop antiasthmatic drugs can reduce the healthcare burden. [46]

Isolating and identifying the bioactive compounds from plants helps the discovery of novel drugs that could serve as the foundation for safer, more effective antiasthmatic treatments. Modern pharmacological and toxicological profiling of these constituents ensures their efficacy and safety. The increasing awareness of the side effects and limitations of synthetic drugs has led to a growing demand for natural and herbal treatments. Researching traditional remedies validates their use and integrates them into mainstream healthcare.

LITERATURE SURVEY

Extensive literature survey reveals numbers of medicinal plants are claimed in traditional system for its effectiveness in respiratory disorder so many plants just evaluated for its activity. Accordingly for present study following medicinal plant & their parts are shortlisted for further literature survey so as to select one or two medicinal plant/s for study.

1. *Anethum graveolens (Apiaceae)(Dill, Shepu)*
2. *Termindus Indica (Leguminosae (Fabaceae),(Amlam, Chinch)*
3. *Zizipus moritiana ` (Rhamnaceae) (Bore)*
4. *Hibiscus rosa sinesis (Malvaceae)(Jaswand)*
5. *Jasminum multiforum (Oleaceae) (Kakda)*
6. *Terminalia Cattappa (Combretaceae)(Indian almond)*
7. *Momordica dioica (Cucurbitaceae) (Kartule)*
8. *Nyctanthes arbor tristis (Oleaceae) (Parijat)*
9. Any other

Literature Review of Plants:

Sr no	Plant name	Plant Part	Pharmacological activities	Conclusion	Ref.
01	*Anethum Graveolen -s*	Leaves	Antiparasitic	The results showed that dill extract can be used as an antiamoebic effect in the liver, suggesting that its daily use could help greatly decrease the incidence of this type of infection.	Al Shimaa et al, 2021
		Seeds	Anticancer	Evaluate research on anticancer activity of methanolic extract of *Anethum graveolens* seeds. Using in vitro anticancer activity assays like MIT assay, NRU assay, Morphological change assay.	Mai M. et al, 2021
		Seeds	Anxiolytic	Studied that the AGS extract significantly decreased he anxiety indices & such anti-anxiety effect of extract might be assumed via its interaction with GABA-ergic receptors.	Rana Shahabi et al, 2022
02	*Ziziphus mauritiana*	Leaves	Sedative & anticonvulsant	Evaluate that the extract reduces locomotor activity, The considerable increase in pentobarbitone sleep hours with the extracts at a higher dose supported the sedative action of *Z. mauritiana*.	Nadim Siddiqui et al, 2024
		Fruits	Wound Healing	The result showed that *Ziziphus mauritiana* may be a potential alternative medication helping wound healing owing to its antioxidant and anti-inflammatory activities.	Nourhan Hisham Shady et al, 2022
		Seed &stem bark	Anti-inflammatory, Anti-diarrhoeal, Hypolycemic	Showed that Stem bark extract showed higher thrombolytic and anti-inflammatory potential, anti-diarrheal ,analgesic and hypoglycemic activity	Md. Khokon et al, 2021
03	*Hibiscus rosa sinensis*	Leaves	Phytochemical and Pharmacologic -al Screening	Demonstrated the antioxidant, antimicrobial, antidiabetic, antiulcer, hepatoprotective, antifertility, antigenotoxic, and antiinflammatory and also studies using animal models analyze the flowers and leaves of for their anti-diabetic and antioxidant properties	Harshad Desai et al, 2022
		Flower	Anti-inflammatory	The result showed the ethanolic extract exhibited significant anti-inflammatory activity on the tested animals during experiment.	Ravindra Mishra et al, 2022

		Leaves	Anti-inflammatory and anti-arthritic	The results showed that an *in-vitro* experiment on hibiscus extracts shows the depression of inflammation. Due to the presence of phytochemicals like phenolic acids, phenolic compounds, alkaloids, tannins, saponins, bioflavonoids and polyphenolic compounds	Talapudi Sruthi *et al.2021*
04	*Terminalia catappa*	Stem Bark	Anti-diarrheal	The Anti-diarrheal activity was assessed by measuring the stool inhibition, gastrointestinal motility and castor oil-induced enter pooling, The results indicate that the aqueous stem bark extract of has a significant dose dependent antidiarrheal activity.	Ahmed et al 2022
		Leaves	Hemostatic	Identified the chemical compounds & The ethanol extract *saponins* and *alkaloids* were fractioned with distilled water and the lowest content were fractioned with hexane. Revealed that flavonoids play the important role in wound healing.	Ni Made Sirat et al 2021
		Bark	Anti-inflammatory and anti-arthritic	Evaluated the extracts found to be effective in reducing the paw edema in the carrageenan-induced inflammation model, and also the extracts exhibited anti-arthritic potential by improving the altered blood parameters, arthritic scores, radiographical, and histopathological changes.	Prasanthi Daram et. al., 2021

Literature Review of Activity:

Sr. no.	Plant	Model	Std. drug	Conclusion	Ref.
1.	*Carissa opaca*	Ovalbumin Sensitized and Ovalbumin-Challenged BALB/c Mice (Bronchoalveolar Lavage Fluid)	Dexamethas-one	The results showed that *C. opaca* possesses antiasthmatic activity via relaxant effect on bronchial smooth muscle which is mediated through calcium channel blockade and antimuscarinic activity.	Muddassar Ali et al, 2024
2.	*Apium graveolen-s*	Milk induced leukocytosis and eosinophilia	Dexamethas-one	Evaluated that the ethanolic extract showed significant Inhibition against leukocytosis and eosinophilia induced by milk as compared to disease control	Vishakha et al , 2022
3.	*Capparis decidua*	Histamine-induced bronchoconstriction in guinea pigs and milk-induced leukocytosis in	Chlorphenir-amine maleate	Ethanolic extract of *C. Decidua* significantly protected the guinea pigs against histamine induced bronchospasm. The ethanolic section has dramatically	Dahiya and Vaghela

		mice, histamine-induced bronchospasm in guinea pigs.		prolonged the latent period of convulsions compared to control.	et al, 2022
4.	*Alpinia calcarata*	Histamine aerosol induced bronchoconstriction in guinea pigs, Milk induced leukocytosis and eosinophilia	Chlorphenir-amine maleate	The result of the investigation showed that the ethanolic extract of *Alpinia calcarata* rhizomes possess anti asthmatic activity which may be because of the chemical moieties i e flavonoid and steroids.	Ravi Prajapati et al, 2022
5.	*Saffron*	Ovalbumin-Induced Airway Model	Salbutamol	Showed that the combined effect of CSE and salbutamol exhibited anti-asthmatic properties via its anti-inflammatory effect and by alleviating immune response	Pranav Nair et al, 2021
6.	*Argemon-e mexicana*	Isolated guinea pig ileum preparation and isolated guinea pig tracheal chain preparation, Histamine and acetylcholine induced bronchospasm in guinea pigs and milk induced eosinophilia in mice models)	Ketotifen fumarate	The result showed that the Ethanolic extract as well as fraction has significantly antagonized the effect of histamine induced contraction on isolated guinea pig ileum.	Rohit Singh et al, 2021
7.	*Eugenia jambolan-a*	Isolated goat tracheal chain preparation, Acetylcholine and Histamine induced bronconstriction in guinea pig, clonidine-induced mast cell degranulation	Atropine sulphate	Evaluated that the aqueous extract showed antihistaminic, mast cell stabilizing and protective in guinea pigs against histamine induced PCD, reduced eosinophilia and leukocytosis and hence possesses potential role in the treatment of asthma.	Bhong Prabha et al, 2021
8.	*Luffa cylindric-a*	Histamine induced contraction of goat tracheal chain, Clonidine induced catalepsy, Milk induced eosinophilia, Passive paw anaphylaxis and OVA	Chlorphenir-amine maleate	The results showed that *Luffa cylindrica* possess significant anti-asthmatic activity which may be ascribed to its anti-allergic, bronchodilating, anti-histaminic, adaptogenic, and anti-inflammatory potential.	Ingale et al, 2020

		induced airway inflammation			
9.	*Syzygium cumini*	Histamine induced bronchoconstriction and mast cell degradation method	Chlorphenir-amine maleate	The results showed that The extract has an anti-inflammatory effect which is demonstrated by its inhibitory effect in carrageenan induced paw edema& also produced significant decrease in bronchoconstriction leading to antiasthmatic activity	Chilivari et al, 2020

Literature Review on analytical technique for Isolation & Identification:

Sr no.	Plant name	Analytical technique	Conclusion	Ref.
1.	*Beta vulgaris*	LC–MS/MS, GC–MS,	In the LC–MS analysis of *B. vulgaris* extract, a major proportion of p_coumaric acid, vannilin, protecatechuic aldehyde and sesamol were detected & in GC–MS analysis were hexahydrofarnesyl acetone.	Özge Üst et al, 2024
2.	*Atraphaxis pyrifolia*	LC-MS	Through LC-MS analysis showed presence of flavonoids, such as gallocatechin/epigallocatechin and feruloyl dopamine, in the stems extract, In the leaves major compounds like 8-Acetoxy-3′,4′,5,5′-tetrahydroxy-7-methoxy-3-α-L-rhamno pyranosyloxy flavone, pyrifolin, and dehydroxypyrifolin	Alima Abilkassymova et al, 2024
3.	*Aegle marmelos*	FTIR ,Mass, NMR,	The FTIR spectra confirms the presence of C=O Aromatic ketone, O-H, C-H stretching, C=C Stretching, Isolation of two compounds was their (A, B), amongst that Mass spectra & NMR spectra confirms the presence of Thymol (A) & Phytol (B).	Kurade and Vandana et al, 2023
4.	*Albizia coriaria*	FTIR, TLC, GC-MS	The analytical studies found the presence of triterpenoid Lupeol, lupenone, betulinic acid, botulin etc	Timothy et al, 2022
5.	*Saraca asoca*	LC-MS	Showed the presence of Flavonoids such as quercetin, naringenin, epiafzelechin are found to be higher than all other compounds responsible for elevated response to various infections and damage.	A. Vignesh et al, 2022
6.	*Myristica dactyloides*	HR-LC-MS	Results prove the presence of Myoinositol, Malabaricone B, Malabaricone C, Malabaricone D, and 1-(2,6-dihydroxyphenyl)-9-(4-hydroxy-3-methoxyphenyl) nonan-1-one previously reported from *M. dactyloides*, along with promising chemical signatures like Monotropein,	Marulasiddaswamy, et al, 2021

			Austrobailignan, Fragransol B, Guaiacin, Myricanone, Nectandrin A etc	
7.	*Hibiscus asper*	GC-MS	The GC-MS analysis revealed the presence of twenty-three bioactive compounds which include 9, 12, 15-octadecatrien-1-ol, n-Hexadecanoic acid, octadecatrienol acid, methyl palmitate, and phytol.	NjokuUgochi Olivia et al, 2021
8.	*Vaccinium bracteatum*	HPLC	The analytical technique isolate the vaccinoside, which had been the only compound isolated extract, along with vanillic acid and protocatechuic acid.	Seul-Gi Lee et al, 2021
9.	*Amomum nilgiricum*	Fourier transform infrared spectrometer (FTIR) &gas chromatography-mass spectrometry (GC-MS)	The FTIR spectrum showed the presence of functional groups alcohols, phenols , alkanes, amines, nitro compounds, aromatics, aliphatic amines, aromatics, alkyl halides, & With the GC_MS study showed The phytoconstituents in the methanol extract were found to be 5-aminooxypentanoic acid, 3,7,9-trioxatricyclo nonane, phenoxy benzene, trimethyl-(2trimethyl silylphenyl) silane, etc.	Narasimhamurthy Konappa et al, 2020
10.	*Teucrium polium*	HR-LCMS	The analytical studies identified the 13R-hydroxy-9E,11Z octadecadienoic acid, dihydrosamidin, valtratum, and cepharantine	EmiraNoumi et al, 2020
11.	*Berginia ciliata*	HR-LCMS	Identified the Myricetin, Coumaric acid, Catechin, Catechol, Quercetin, Ferulic acid, Taxifolin, Gallic acid, Dimethyl cafeic acid, Terpenone, Daidzein, Khivorin, Dihydrogambogic acid, Resorcylic acid, Chrysophanol and Emodin	Prashant Neupane et al, 2020
12.	*Eugenia calycina*	LC-MS	The LC-MS based targeted quantitative analysis showed a high phenolic content in all plant parts in which the ellagic acid was the main phenolic compound, additionally ellagic acid, myricitrin and epicatechin gallate as the main phenolic compounds in the Eugenia calycina	N.M.Peixoto Araujo, et al, 2020

Materials and Methods

- **Plant Material:**

  The selected plant part/s will be collected from known sources and authenticated by an expert botanist.

- **Processing of Plant Material:**

  The collected crude drugs will be processed according to official standards, including steps such as drying, grinding, and sieving [16].

- **Standardization of Plant Material:**

  Phytochemical examinations will be conducted using standard methods, including the estimation of extractive value, acid and water-soluble ash, foreign matter, and loss on drying (LOD) etc

- **Pharmacognostic Evaluation of plant material:**

  The parts of the selected plant/s will be subjected to Pharmacognostic evaluation, including morphological evaluation, microscopical evaluation, and powder characteristics etc [17]

- **Extraction of Plant material:**

  The powdered form of the selected plant material will undergo extraction, with the choice of solvent and extraction method determined based on the chemical constituents of the selected plant parts and the nature of those constituents. [18].

- **Phytochemical Screening of selected plant extract/s for**

  Qualitative analysis will be conducted to detect phytoconstituents, which will then be confirmed using suitable chromatographic techniques.

  Quantitative analysis will be performed to determine the total polyphenols, total flavonoids etc [19].

- **Pharmacological screening of plant extract/s**

  The extract/s of the selected plant parts, either individually or in combination, will be evaluated for

  i. ***In vitro* Antioxidant study**.

  In vitro antioxidant activities for the extract/s will be carried out using appropriate *in-vitro* antioxidant model like; DPPH assay

  ii. **Safe dose calculation:**

  The safe dose calculation of plant extract/s for efficacy evaluation will be conducted in accordance with OECD Guidelines for Acute Toxicity Study: Class Method (423) [23].

iii. **Repeated dose oral toxicity study**

Repeated dose oral toxicity study of plant extract/s will be carried out as per OECD Guidelines for 'Repeated dose oral toxicity study: Class Method (407)

iv. **Pharmacological screening for *in-vivo* anti-inflammatory activity**

Carrageenan-induced rat paw edema or similar method/s will be used to evaluate the potential role of plant extract/s in asthma-like respiratory disorders.

v. **Pharmacological screening for anti-asthmatic activity**

Following preliminary phytochemical evaluation and assessment of antioxidant and anti-inflammatory activities, the most effective plant extract/s will be evaluated for bronchodilatory and bronchoprotective effects using suitable *in-vitro* or preclinical models, employing modern tools such as a data acquisition system.

In-vitro & in-vivo Models for antiasthmatic activity respectively:

- ***In-vitro* Models**
  - Isolated goat tracheal chain preparation
  - Mast cell degranulation in rats
- ***In-vivo* Models**
  - Acetylcholine and Histamine induced bronconstriction in guinea pigs
  - Milk-induced eosinophilia and leukocytosis
  - Passive paw anaphylaxis in mice etc

One or two models from the above list will be used to study the anti-asthmatic activity of various plant extract/s.

- **Isolation & identification of Antiasthmatic bioactive constituent**

i. Selection of extract/s

After preliminary phytochemical and pharmacological evaluations for antioxidant, anti-inflammatory, and antiasthmatic activities, the most potent extract/s will be selected for further studies.

ii. HR-LCMS Study of selected extract:

The selected extract/s will be subjected to HR-LCMS studies to confirm the presence of various phytoconstituents in extract/s.

The abundant bioactive phytoconstituent will be subjected for further study**.**

iii. Fractionation:

Further as per the results of HR-LCMS , the extract/s will be subjected to fractionation for purification & isolation of bioactive phytoconstituent & the

fractionation will be done by using solvent fractionation (A technique used to separate components of a mixture by exploiting differences in their polarity)

iv. Phytochemical evaluation of fraction/s:

The resulting fraction/s will undergo qualitative analysis, including identification tests, and HPTLC studies.

v. Identification of phytoconstituent/s

The phytoconstituent/s will be identified by using LC-MS / GC-MS spectroscopic techniques to confirm presence of bioactive constituent in fraction/s.

vi. Pharmacological screening of fraction/s:

Finally, the isolated phytoconstituent/s or fraction/s will be subjected to pharmacological confirmation of their antiasthmatic activity by evaluating bronchodilatory and bronchoprotective effects using suitable *in-vitro* or preclinical models, with modern tools such as a data acquisition system.

YEAR WISE PLAN OF WORK:

Sr. No.	Work	Period in months
1.	Literature survey	06
2	Plant collection and preliminary screening	03
3	Extraction of plant material	05
4	Phytochemical evaluation	04
5	Pharmacological screening	08
6	Isolation and Identification of Phytoconstituents/s	04
7	Pharmacological evaluation of isolated Phytoconstituents	02
8	Compilation of data & Thesis writing	04
	Total duration of project	**36 months**

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